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Numeric System for the Energetical Dispatchering

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ABSTRACT. Technical and economic reasons demand an exact knowledge of the energetic parameters such as: potential, electrical current, consumed active or reactive energy, and also of the qualitative parameters of the energy (frequency, harmonic distorsions).
Technically and economically speaking, emitting an energy invoice to an industrial consumer assumes going through some stages: concluding an initial contract for providing electrical energy, in which a contracted active power and a contracted quantity of energy is specified monthly; the establishment of the energy consume recorded by the consumer; the checking up of the fitting in the contracted active power limit; the calculation and the emitting of the energy invoice.
In the case of a judicious choice of the contracted power, for an industrial factory, economies can be made, which can reach the sum of thousands of millions monthly. But this thing includes a risk, because it is based on contracting a smaller active power, and on monitoring carefully and in real time of it using systems for the energetic dispatching.

ЧИСЛЕНО МОДЕЛИРАНЕ НА ДИСПЕЧЕРСКА СИСТЕМА ЗА РАЗПРЕДЕЛЕНИЕТО НА ЕЛЕКТРИЧЕСКА ЕНЕРГИЯ
РЕЗЮМЕ. Точното познаване на енергийните параметри като напрежение, променлив ток, консумирана активна и реактивна мощност, както и параметрите, характеризиращи качеството на мощността (честота, висши хармоници) е необходимо по технически и икономически причини.
От техническа и икономическа гледна точка издаването на фактура на промишлен консуматор преминава през няколко етапа: сключване на първоначален годишен договор за предоставяне на електрическа енергия, в който се договаря активната мощност и разпределението по месеци и тримесечия; регистриране на консумацията на енергия при консуматора; проверка за съответствие с договорената активна мощност; изчисляване и издаване на фактура
При положение, че промишленото предприятие договорира разумно доставяната енергия, могат да се постигнат значителни икономии на месец. Но това крие известен риск, тъй като се основава на договаряне на по-малка активна мощност и постоянно следене на консумацията в реално време с помощта на диспечерска система за разпределение на енергията.
Key words: *numerical system, energetic dispatching*

The necessity of the energetic dispatching

The energetic dispatching is necessary because of technical and economical reasons. To conclude a contract for providing electrical energy in optimum economical conditions, a close and permanent supervision of the energetic parameters is necessary. In the case of a factory which generally contracts a monthly active power of 20 MW, implementing an efficient energetic dispatching system, will contract, with no unusual problems, a monthly active power of 18,5 MW. For this thing to be possible, the following things are necessary:

- a stabile and reliable functioning of the dispatching system;
- the necessity of flattening the charge curve of the factory;
- educating the personnel because it exists the risk that through contracting a too low power, the activity of some big equipments for energy consume, might be blocked and these equipments are essential for the production process.

At a correct functioning of the dispatching system economies can be made, which can rise up to hundred of millions monthly.

Contracting a too low active power which is not technically justified, may lead it to exceed its value easily. SC Electrica SA, through the contract to provide electrical energy an higher active power than the one contracted is invoiced, with the same cost only for the situations when the value of the active power is not exceeded with more than 15% of the value of the contracted active power. For the cases when the consumed power exceeds with more than 15%, the difference is paid at a triple rate compared to the usual one.

The dispatching also has as a purpose taking care of the human resources and the materials function of the performance of the composing technological lines. The performance of a technological line can be deduced from the energetic parameters: active power and power factor. If the consumed energy is too low in accordance with the installed power, then the line works empty trip (if an electrical engine works empty trip, we we'll have a low power factor).

Picking up energetic data may be done at long intervals of time (more than ten seconds), case in which we are dealing with measuring/countering or at short or very short intervals of time, a frequency of 50 measurements (read, transmitted and processed) in the time unity, case in which we can follow up rapid processes, we can draw charge curves, we can diagnostic different defects.

If the link between the acquisition board and the stocking and processing unity (the computer) is bidirectional, then adjustment curls can be implemented for the processes which don't need a very high reaction speed, but with a complicated adjustment algorithm which can only be numerically implemented.

In this paper here are exposed the methods for picking up the energetic data, for their local stocking and also for their transmission to a great distance. No matter if the data will be used in dispatching the energy, in predictions, plans, in optimum repartitions of the energetic parameters or in making easy the leading assignments, these principles remain unchanged.

Energetic dispatching system

The general structure of an energetic dispatching system is the following:

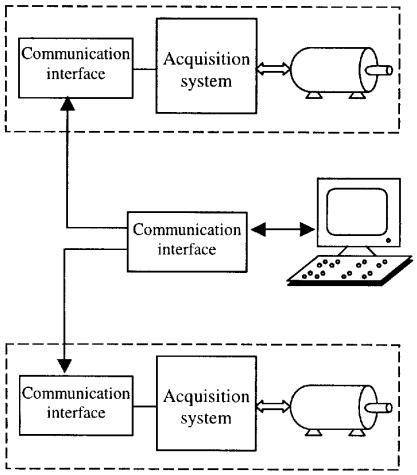

Fig. 1.

The analogical conditioning module is composed of the current and potential traductors, (usually measure transformers), mono interchange precision rectifiers, effective value converters, and also of the amplifying and limitation circuits for obtaining numerical signals which are necessary to the measuring of the phase difference between electrical current and potential and also the energy supply network frequency.

The principle scheme and the time diagrams corresponding to the different signals are presented in Fig. 2 şi Fig. 3.

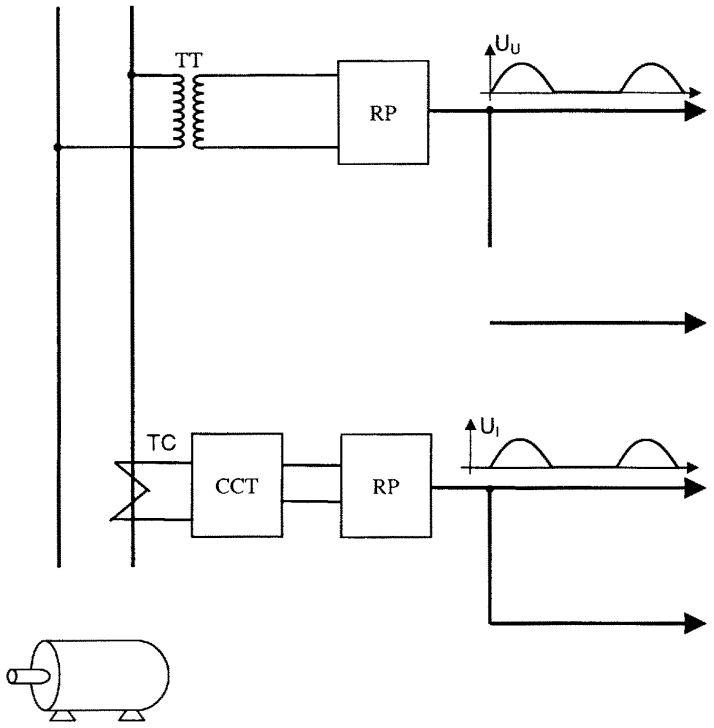

Fig. 2.

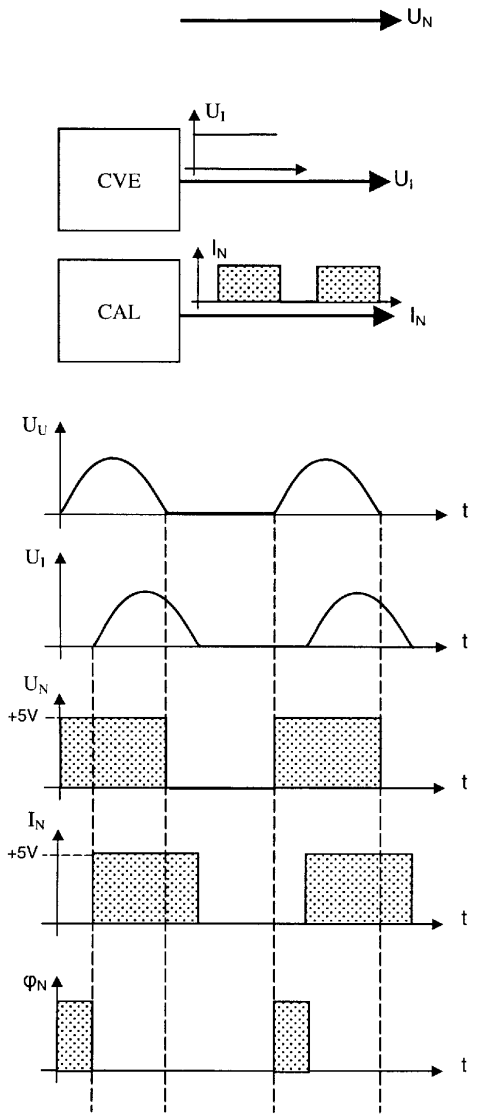

Fig. 3.

Measure and primary calculus module

It is an acquisition and numerical process of the data made around a microcontroller AT89C2051 with the following structure:

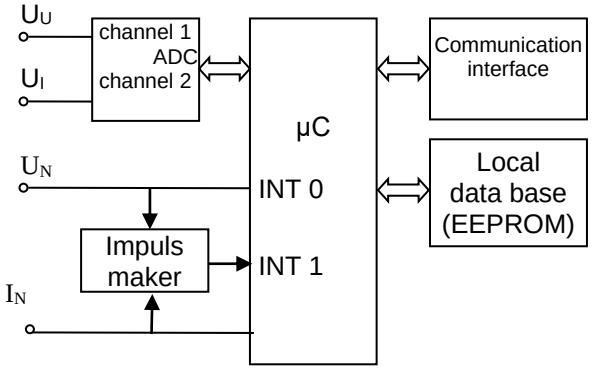

Fig. 4.

The system with μC controls the acquisition of the current and potential signals, and, also measuring with the help of the two intern timers the duration of the potential signal for the calculation of the frequency and also the duration between the appearance of the potential and current impulses.

Analog numerical conversions are made with a analog numeric converter MAX 1271 with 8 channels for input, with a 12 bits resolution and serial communication with the μC.

The μC transmits these data towards the central dispatcher using a serial communication interface RS232 for small distances (some meters) or RS 485 for greater distances (under 1200 m). In case the data must be delivered at even greater distances, there are used repeaters or radio modems.

Also, the system with μC makes a local data base using a EEPROM serial memory where are memorized the medium values of the current, potential, phase difference, and frequency per second, minute, hour, day, week, year, values which can be read by the general energetic dispatcher.

μC AT89C2051 has 2k Bytes of flash memory (Electricaly Erasable Programable Read Only Memory) which is sufficient for the programme necessities. The working frequency of a microcontroller is up to 24MHz. In this way, rapid measurements may be done. If a great number of measurements would be done, there would appear problems concerning the overload of the channel of communications and of the size of the data base. Because the dynamics of the data is low enough in most of the applications, growing up only during the transitory regimes (on/off consumers) it is sufficient only one measurement per period, and the transmitted data are an average of the values during a second.

The central dispatcher

It receives from the acquisition systems measured energetic parameters (line current, line potential, power factor, frequency). With these quantities there will be calculated:

- momentary active power;
- average active power on the current interval;
- momentary reactive power;
- average reactive power on the current interval;
- momentary apparent power;
- average apparent power on the current interval;
- consumed active energy;
- consumed reactive energy.

The dispatching program has at it's base a SQL data base server, namely „Microsoft SQL Server 7.0". The contribution at this part of the software is limited at the so-called data base, and at the ODBC communication part, and at the ODBC-SQL soft for self configuration. The operating system which is used as a platform is „Windows 2000 Professional" and represents the only soft which needs license. SQL server is also in the „desktop" version which is freeware. Also belonging to S.Q. is the chosen internet server: „Internet information services" and the contribution is represented by the configuration of the server and the proper web page.

Given the fact that the web page is not static (the values of the energetic quantities being modified at each second), it has been used a server which is configured for an ASP (Active Server Page).

The software structure is presented in the fig. 5:

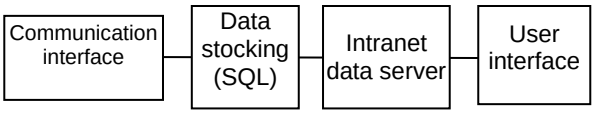

Fig. 5.

Conclusions

The main advantages of the dispatching were already reminded in this paper, but there will be presented the advantages of using some hardware and software systems dedicated to the application from the point of view of the economical and technical reasons.

Economically, the hardware part of the project in discussion has a low cost for the mono phased version. For the tri-phased version the cost doesn't get triple, and moreover, is much lower than the price of a similar dedicated device.

Due to the data distribution through intranet/internet, other costs for the physical or software implementation of the network don't appear. The clients of this web page won't need license but only for the operating system, which is very useful to any computer, in any case. The requirements from the point of view of the client's computer's performance are minimum, because it uses only the internet browser to visualize the data.

It must also be reminded that the server is the only which runs the dispatching software and which needs performances ensured by any server.

The companies which make dispatching programs, the foreign ones (Circutor) and also the Romanian ones (DaQLab, Softrom, Comtec) give license to each computer: the server and the clients. The licence may rise up to values which may exceed 10.000$ in the case of „coorporate" license (the number of computers on which the soft is used does not matter if they are from the same company).

The difference this soft brings, next to the economical is the technical one, more exactly the necessary changes don't have to be done by the producer of the software, but by a personnel medium qualified in this field, because he needs only to change the web page, which is a much accessible thing to do.

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